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Review

Taeniasis-cysticercosis complex and tuberculosis in food

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Although in 2020 the country's Gross Domestic Product (GDP) declined 4.1% compared to the previous year, the participation of livestock in the same period increased its representation from 8.4 to 10%. It is estimated that Brazil's contribution to the world food market has grown from 20.6 billion to 100 billion and the prospects are for greater increases for the coming years. In terms of people fed, the numbers were 800 million people. Thus, it is important to avoid the occurrence of illnesses, especially those transmitted by food. Included in this group are zoonosis, defined as diseases transmitted by animals to humans, which can be bacterial, viral or parasitic. According to the World Organization for Animal Health, 60% of human infectious diseases are zoonotic and 75% of emerging infectious disease agents in man is of animal origin. Among the main ones are the taeniasis-cysticercosis complex and tuberculosis. They are a global public health problem and prevent the efficient production of food. This work is a literature review that aimed to discuss the causative agents of these diseases, as well as the characteristics, contamination in food and possible measures for its control.

Key words: Zoonosis, production, feeding, risk.

INTRODUCTION

Although in 2020 the country's Gross Domestic Product (GDP) declined 4.1% compared to the previous year, the participation of livestock in the same period increased its representativeness, going from 8.4 to 10%. It is estimated that Brazil's contribution to the world food market has grown from 20.6 billion to 100 billion dollars and the perspectives are for greater increases for the coming years. In terms of people fed, the number was 800 million people (EMBRAPA, 2021a,b; ABIEC, 2021).

Thus, to improve commercial performance and conquer new markets, it is important to avoid the occurrence of diseases, especially those transmitted by food. Some are considered zoonosis, defined as diseases or infections transmitted by animals to humans, which can be bacterial, viral or parasitic. According to the World Organization for Animal Health – OIE (2020b), 60% of human infectious diseases are zoonotic and 75% of emerging infectious disease agents in man are from animal origin. They constitute a public health problem and prevent the efficient production of animal foods. Among the main ones in this group are the taeniasis-cysticercosis complex and tuberculosis (WHO, 2020).

The taeniasis-cysticercosis complex is included in the 20 most important Neglected Tropical Diseases (NTDs)

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in the world, whose mark is the control and eradication for the next ten years. Among the areas of greatest incidence are Latin America, in Brazil it has records in all regions. Tuberculosis is the ninth leading cause of death worldwide. It is estimated that only two-thirds of all cases are reported. The BRICS (Brazil, Russia, India, China and South Africa) are responsible for 53% of all cases in the world. Brazil remains among the 30 countries with the highest occurrence. Therefore, the control of the disease in the world is considered a priority by the World Health Organization (BRASIL, 2021; SBMT, 2021).

Factors that favor the occurrence and dissemination in the country are the poor sanitation conditions; there is no treatment of 49% of sewage, inadequate facilities, eating habits such as the consumption of uninspected meat and unpasteurized milk (Acevedo Nieto et al., 2012; SNIS, 2021). This work is a literature review that aimed to discuss the causative agents of the taeniasis-cysticercosis and tuberculosis complex, as well as the characteristics of these diseases, food contamination and possible measures for its control.

METHODOLOGY

The present work is a literature review, thus, published data and updates for the years 2011 to 2021 were consulted. 24 academic articles, 7 dissertations, 1 thesis, 4 monographs, 20 organizations with data and local and international censuses, 4 books, 1 public library collection, 2 technical circulars and 1 summary of event proceedings were used. The period ranged from March to August 2021. As a strategy, keywords in Portuguese and English were used in the search: taeniasis, cysticercosis, taeniasis-cysticercosis complex, *Taenia solium*, *Taenia saginata,* neglected tropical diseases, tuberculosis zoonotic, *Mycobacterium bovis* and consumption of raw milk, consumption of unpausterized milk. Despite the data presented, it was difficult to find more recent detailed data on the characterization of the presence of these microorganisms in products from animal origin, especially in informal marketing, the quantity of consumption of these foods and the issue of risks related to the health of the consuming population, which demonstrates the importance of further explanations in this area.

ECONOMIC AND PUBLIC HEALTH ASPECTS

Humans always had a close relationship with animals. Over the years, they were used as transport, work, company and mainly in food. However, they can be a source of infectious diseases caused by viruses, bacteria and parasites, which can be transmitted to the human population, called zoonosis (Zanella, 2016; WHO, 2020).

They represent a major public health problem around the world and also put at risk the production and trade of animal products, causing interruptions, restrictions, investment and commercial opportunities losses due to their health status. Its impacts exceed 20% of livestock production losses worldwide. With this, there is a predisposition to increase poverty, considering that currently 1 billion farmers survive from its production (Zanella, 2016).

They comprise a large percentage of all newly identified infectious diseases as well as many existing ones. There are more than 200 known, among which there is the taeniasis-cysticercosis complex and tuberculosis (Zanella, 2016; WHO, 2021). Found predominantly in developing countries, they affect populations that live in situations of poverty and vulnerability where there are groups or human populations living with animals under conditions that favor the transmission and maintenance of the zoonotic cycle. As well as restricting services, infrastructure and operational facilities for the supply of drinking water, sanitary sewage, cleaning, solid waste management and urban rainwater (SBMT, 2021).

The taeniasis-cysticercosis complex is included in the group of the 20 most important Neglected Tropical Diseases (NTDs) in the world according to the World Health Organization. They harm the lives of about a billion people and are responsible for causing the death, annually, of about half a million people (Mableson et al., 2014).

Traditionally, they occupy a secondary place in national and international health agendas, neglected due to the lack of information on their geographic distribution and lack of resources for their control. Despite being feared by the affected populations, they are little known and understood elsewhere. A new script for the period 2021 to 2030 was launched. The global goals and milestones are for prevention, control, elimination or eradication (SBMT, 2021).

Tuberculosis remains an important public health problem worldwide. It is estimated that in 2019, around ten million people worldwide developed and 1.2 million died from the disease. Brazil remains among the 30 countries with a high burden, and is therefore considered a priority for disease control in the world by the World Health Organization (WHO). In 2019, around 4.500 deaths from the disease were reported, with a mortality rate of 2.2 deaths per 100,000 inhabitants, whereas in 2020, the country registered 66,819 new cases, with an incidence rate of 31.6 cases per 100,000 inhabitants (BRASIL, 2021).

It is believed that 10% of human tuberculosis cases originate from bovine tuberculosis. Generally, care in differentiating the etiological agent that promotes the disease in humans is not performed. Thus, there is possibly underreporting of cases of zoonotic tuberculosis (OIE, 2020a; Garcia et al., 2021).

ZOONOSIS PREVALENCE IN FOOD

Teniasis-cysticercosis complex

The existence of parasitism of the genus *Taenia* in

humans is dated back to prehistory. Studies show that it appeared before the domestication of animals and agricultural evolution (Costa, 2021). It is believed that cysticercosis was first described in swine by the Greek thinker Aristotle, as cysticercosis and taeniasis were two distinct and independent diseases. Since then, there has been a misconception that considered the pig as a transmitter of the dreaded disease (Silva, 2011). Only in the 19th century, after nearly two millennia since the first description, the cycle of the disease became clear, as well as the indication that it is transmitted by man and not by infected animals, as previously thought (Buschmann, 2011).

Differentiation of cysticercosis and taeniasis

They are diseases caused by the same cestode at different stages of its life cycle. Taeniasis is a parasitosis caused by the presence of the adult form of *T. saginata* and *T. solium* in the small intestine of men. Cysticercosis, on the other hand, is a disease caused by the presence of the larval form of these tapeworms, Cisticercus bovis and Cisticercus cellulosae in bovine, swine or human tissues, respectively (CDC, 2021). Cysticercus cellulosae requires greater public health attention, because if *T. solium* eggs infect humans, cysticercus develops in the tissues and can cause more serious repercussions when reaching the brain (neurocysticercosis), the ocular region (intraocular cysticercosis) and other structures. There is no occurrence of the development of cysticercosis by *T. saginata* in men (Silva, 2011).

Epidemiology

T. saginata and *T. solium* have worldwide distribution. According to estimates by the World Health Organization (WHO), there are at least 2.5 million people infected with taeniasis in the world. Infections are more prevalent in communities in developing countries with poor sanitation, inadequate disposal of human fecal excrement and where people have the habit of eating raw or undercooked meat. These factors favor the spread of the disease. In this scenario, higher rates were observed in individuals from Latin America, Eastern Europe, Russia, Sub-Saharan Africa, India and Asia (CDC, 2017).

T. solium has greater prominence due to the possibility of man developing cysticercosis. It primarily affects the health of subsistence farming communities. The WHO estimated the occurrence of 50,000 deaths annually from complications of neurocysticercosis. It is a serious public health problem since the disease is the preventable cause of epilepsy; it is estimated that it constitutes 30% of all cases where it is endemic. In specific communities, the association between diseases can reach 70%. In 2015, the WHO Foodborne Disease Burden Epidemiology Reference Group identified *T. solium* as the leading cause of deaths from foodborne diseases resulting in a considerable total of 2.8 million disability-adjusted life years (DALYs) (CDC, 2019; WHO, 2021). In Brazil, it has been increasingly diagnosed, mainly in the South and Southeast regions, both in neurology and neurosurgery services, and in anatomopathological studies (Silva, 2011).

Etiological agent and reservoir

T. solium and *T. saginata* belong to the class *Cestoidea*, order *Cyclophillidea*, family *Taenidae* and genus *Taeni*a. In the larval form, *Cysticercus cellulosae* corresponds to *T. solium*, whose intermediate host is swine and man. *Cysticercus bovis* as well as *T. saginata* has as an intermediate host, the bovine. The egg form of *T. saginata* develops cysticercosis in bovines, and of *T. solium* in swine or humans. Man is the only definitive host of the adult tapeworm form (Toledo et al., 2018).

Biological cycle and transmission

The cycle implies two hosts. The definitive is what lodges the parasite in the adult stage and the intermediary, which lodges the cysticercus. It is composed of three phases regarding the population of parasites: adult in the definitive host, eggs in the environment and cysticerci (larval phase) in the intermediate host (Acevedo-Nieto, 2012; Toledo et al., 2018).

It starts with the definitive host, the human, contaminated, being a carrier of adult *Taenia* in its intestine. Along with your feces, it eliminates proglottids or eggs that contaminate the environment. The intermediate hosts, swine (*T. solium*) and bovine (*T. saginata*), when consuming water or food contaminated with these eggs, become infected (CDC, 2017).

After this ingestion, the embryos (oncospheres) are released from the egg in the small intestine by the action of digestive juices and bile. The larval stages correspond to *Cysticercus cellulosae* (swine) and *Cysticercus bovis* (bovine). Oncospheres penetrate the intestinal wall and within 24 to 72 h, diffuse into the body through the bloodstream. Cysticerci then form in the skeletal and cardiac muscles, hence the name cysticercosis (Toledo et al., 2018).

When the man, in turn, ingests viable cysticerci from contaminated pork or beef, he develops taeniasis, which is the presence of *Taenia* in the intestine. After three months of ingestion of the cyst the man begins to eliminate pregnant proglottids in the stool and then the cycle is restarted. An infected individual can shed thousands of eggs a day, free in the feces or with intact segments that can survive in the environment for several months. These contaminate pastures and water

(Acevedo-Nieto, 2011).

The human can also be the intermediary host by ingesting *T. solium* eggs from food contaminated with human feces with taeniasis or by self-infection. In this way, he develops cysticercosis. There are no records regarding *T. saginata* (Del Brutto and Garcia, 2012).

When ingested, these cysticerci can lodge in different regions of the body, including the central nervous system. It can affect any organ in the body, but the brain parenchyma is the most common location in the central nervous system (60-90%), where it causes neurocysticercosis. Based on this, it is considered the most serious form, triggering several inflammatory reactions which can result in death (Mahale et al., 2015).

Factors responsible for the high prevalence

The incidence of taeniasis-cysticercosis complex is increased in situations of deficient sanitary conditions associated with rearing systems, inadequate facilities, cultural habits, people with taeniasis involved in the rearing and trade of meat and meat products without sanitary inspection (Calvo et al., 2013; Hill et al., 2014).

In creations with low technification as regards animals in extensive regime, there is a great possibility of the presence of the main risk factors for this disease in animals. The swines in this regime which roam free in the environment do not have any facilities or improvements. Animals are kept in the field during all stages of life, subject to the elements. As well as bovine, it is the main type of creation used in Brazilian livestock, in which animals have free access to pastures, streams and rivers that may be contaminated by human feces. This factor facilitates the occurrence of cysticercosis in animals (Dutra et al., 2012).

The rainfall in this sense favors the dissemination and contamination of pasture. Water plays an important role in dispersing the parasite's eggs in the environment. The high numbers of cases of cysticercosis in regions bathed by rivers and streams may be related to their contamination by tapeworm eggs. In addition to situations where rivers and canals polluted with sewage overflow. In Brazil, there are still almost 35 million inhabitants without treated water services, and approximately 100 million people without access to sewage collection, representing 49%. The country still does not treat half of the sewage (SNIS, 2021).

There is also a lack of cesspools in rural areas, contributing to environmental pollution, and cases in which animals end up ingesting human feces are common. The use of irrigated vegetable gardens and orchards with contaminated water is a major source of infection for humans (Toledo et al., 2018).

Associated with all these factors, in many regions the practice of slaughtering bovine and swine inside the property is common, without veterinary inspection, where the meat is intended for family consumption and used as a bargaining chip in rural communities or sold to butchers (Acevedo-Nieto, 2011).

In this context, the consumption of this uninspected meat is an important risk factor that contributes to the maintenance of the disease. Associated with this, there is the way of cooking, undercooked or overcooked, inadequate hygiene habits and contamination from dirty hands.

It is estimated that in most cities, animals are slaughtered and sold without sanitary inspection, so that carcasses parasitized with cysticercus are not even identified, putting meat consumers at risk and contributing to the spread of this zoonosis. They represent 28%, but it is believed that this value is much higher (ABIEC, 2021).

Contamination in food

In 2020, more than 2.3 billion people did not have access to adequate food and suffered some type of food insecurity (FI); it is noted that it increased in one year to a value equivalent to the previous five (UNICEF, 2021).

In Brazil, of the 211.7 million population, 116.8 million also lived with this reality. It was observed that in rural areas of the country the serious situation corresponded to twice as much, in situations where there was no availability of water for food production. In data from 2018-2019, the general sewage network was present in less than half of these households (FAO, 2021).

In this context, the high frequency of foodborne diseases (FD) is related to individuals subjected to conditions of lack of basic sanitation, social inequality and socioeconomic vulnerability.

With this scenario, many individuals choose to purchase food from the informal market, due to lower costs. Although it is believed that the production of uninspected meat represents 28% of production, this value is much higher (ABIEC, 2021). It is observed that in most cities, animals are slaughtered and sold without sanitary inspection.

In studies carried out by Matos et al. (2017) in the state of Sergipe, in 9 open markets, it was observed that 43% buy beef exclusively in these places due to the price. As in the work carried out by Diniz et al. (2012) in fairs from 5 municipalities in Pernambuco, it was analyzed that 60% opted for beef and 51% did not know the origin.

In Goiás, 53% opted for the informal market (Pádua, 2011). This reality was also present in Montes Claros, Minas Gerais, where 36.36% of the meat was of unknown origin (Lage et al., 2018). In two municipalities in Pará, Ipixuna and Paragominas, respectively, 63.33 and 45% of respondents choose to buy beef because they believe it is fresh and affordable (Batista and Farias, 2015).

Associated with these factors, the inspected

slaughterhouses detected 20 to 50% of infected animals resulting from mild infections, which make it more difficult. The preferred sites for cysticerci in cattle are the heart, diaphragm, tongue, and masseter muscles, pterygoids, while the swine ones are in the tongue, ham, shoulder, intercostal muscles and heart (Rossi et al., 2014).

Prevention

Prophylaxis aims to interrupt the evolutionary cycle of the occurrence of this complex. It depends on several associated factors, such as: men's health education emphasizing the relevance of hygiene habits; the detection and treatment of the parasitized individual, as he is the disseminator of cysticercosis; the use of sanitary facilities with cesspools or sewage systems; and the ingestion of well-cooked or roasted meat or meat products (Germano and Germano, 2015).

Regarding the measures, it is necessary to clarify the population about the risks arising from the consumption of uninspected meat. In addition to fighting, the practice of clandestine slaughter ensures the parasitic sterilization of wastewater at the exit of effluents from urban areas and the use of septic tanks in rural areas. Slaughtered animals that are positive for bovine cysticercosis need to be tracked with further treatment by the health authorities.

Tuberculosis

Tuberculosis is a disease that has records since prehistory and can be considered the microbial agent that most victimized humanity. There are reports of its occurrence in humans in the region of India in manuscripts dated 2000 B.C. (Rocha, 2016; CCMS, 2021).

It is estimated that from 1700 to 1900, it was responsible for the death of approximately 1 billion people. The average annual mortality rate was 7 million people. It was named in 1839 by Johann Lukas Schoenlein and had not been identified as a single disease until the second decade of the 19th century (CCMS, 2021).

Bovine tuberculosis is a zoonosis with a chronic evolution and debilitating effect, characterized by the formation of a granulomatous lesion, with a nodular aspect, called “tubercle”.

Epidemiology

This disease is considered worldwide distribution. It is more prevalent in developing countries such as Asia, Africa and Latin America, where knowledge about the epidemiology of the disease and concrete actions for its control are limited (WHO, 2020; Garcia et al., 2021).

It remains a major public health problem worldwide. It is estimated that in 2019, around ten million people in the world developed TB and 1.2 million died from the disease. In relation to Brazil, the country remains among the 30 countries with high burden, and is therefore considered a priority for disease control in the world by the World Health Organization (WHO). In 2020, Brazil registered 66,819 new cases of TB, with an incidence rate of 31.6 cases per 100,000 inhabitants (BRASIL, 2021).

It is estimated that 10% of human tuberculosis cases originate from bovine tuberculosis (OIE, 2020a). Usually, the care in differentiating the etiological agent that promotes the case of human tuberculosis is not performed. Thus, there is possibly underreporting of cases of zoonotic tuberculosis, as these cases are reported only as human tuberculosis (BRASIL, 2021).

It is endemic and more recurrent in farms with activities in dairy cattle, especially in those with high production. The states with most notified cases of bovine tuberculosis were Rio Grande do Sul (12,390 notifications), Santa Catarina (8,898 notifications), Paraná (8,262 notifications) and Minas Gerais (3,274 notifications). These states are extremely representative for dairy cattle (Garcia et al., 2021).

Etiological agent and reservoir

It belongs to the phylum of actinobacteria, suborder *Corynebacterineae,* family *Mycobacteriaceae,* which includes the genera *Mycobacterium, Corynebacterium*, *Nocardia*, among others. *Mycobacterium* is composed of more than 130 species and subspecies (Rocha, 2016). Among the species of epidemiological importance, there is *M. bovis*. Previously, it was considered a variant of *M. tuberculosis* and called *M. tuberculosis* variant bovis or *M. tuberculosis* subspecies bovis.

Formed by gram-positive bacilli, strict aerobics, immobile, acid alcohol resistant, non-spore-forming and devoid of capsules or flagella. Bovines are considered the main reservoirs of *M. bovis* and constitute the main source of infection for humans. However, the disease has been reported in other domestic and wild animals. The species is capable of infecting sheep, goats, dogs, cats, horses, pigs, some birds such as parrots and wild species such as wild boar, deer and antelope (Ferreira, 2019; OIE, 2021).

Factors associated with higher prevalence

The main way of introducing the disease into a herd is the acquisition of infected animals, without preventive tuberculin tests, which is strongly influenced by the characteristics of the breeding unit, such as type of farm,

herd size, population density and zootechnical and sanitary practices (USDA, 2020).

Farms with more intensive dairy farming, mechanized milking system, more than 22 animals, and have a greater tendency to move animals that favors the spread of the disease. The handling of more grouped animals, inadequate facilities, no ventilation, no penetration of the sun, no hygiene practices, and contaminated dams provide greater dissemination (Veloso, 2014).

Transferability

Tuberculosis by *M. bovis* is generally chronic in nature, slowly progressive. The usual route of infection in bovines herds is respiratory, by inhaling infected droplets from aerosols when a sick animal coughs or has runny nose. Calves can become contaminated by ingesting colostrum or milk from infected cows. Less common routes are feces, urine, vaginal, uterine and semen secretions. Cows with genital tuberculosis rarely transmit the disease to the fetus through the placental route (OIE, 2020a).

As regards its transmissibility, this can occur from a sick animal to man by breathing aerosols, by contact with infected tissues in slaughterhouses or butchers, and mainly by the digestive route when ingesting raw milk or unpasteurized dairy products and raw meat. The risk is greater for children, elderly and people with immune deficiency, in which the extrapulmonary forms mainly occur (WHO, 2017).

The disease has a slow evolution and can take months or even years for the infected animal to die. Consequently, there may be cases of an asymptomatic animal being the transmitter of the disease, eliminating the bacteria within the herd before showing clinical signs. Therefore, the movement of infected domestic animals is one of the main ways of spreading the disease (OIE, 2021).

Contamination in food

Due to the aforementioned factors, the risk of contracting *M. bovis* from eating contaminated meat is more difficult compared to consuming milk. Human tuberculosis caused by *M. bovis* has become very rare in countries that use pasteurized milk and eradication programs. However, this disease continues to be reported in areas where the disease is poorly controlled.

The consumption of raw milk and unpasteurized dairy products is still common in some African countries. In studies conducted in Tanzania and in the province of KwaZulu-Natal, South Africa, it was found that respectively more than 90 and 97% of livestock-owning households reported daily consumption of milk. Only 39% of families in Tanzania and 3% in South Africa use any heat treatment. In addition to the cultural issues of some groups, such as the Massai people who, during the dry season, when milk production is insufficient, cut the animals' jugular vein, collect blood and drink or mix it with milk. This factors those results in greater susceptibility (Chidumayo, 2021; Pal et al., 2014; Michel, 2015).

In China, Xu et al. (2021) when carrying out a wide range of tests on 13,345 cows from eight dairy farms in three provinces, advanced infection was detected in 5.64% of the animals, suggesting a high prevalence of tuberculosis in these farms. In cattle distributed at 11 experimental stations in the Punjab province of Pakistan, the prevalence of *M. bovis* was 7.6% (Javed et al., 2011).

With regard to Brazil, the sale of uninspected raw milk, known as the informal market, has been a social, economic and public health problem throughout the country. Since 1969, there has been a ban; however, there is still purchase of this product due to misconceptions. They believe it is healthier, more flavorful, in addition to having a more affordable price. Besides, mainly small producers, in order to increase their profitability, sell directly to consumers. It is estimated that 27% is of this origin (Ribeiro-Júnior et al., 2020; Rocha et al., 2020).

Veloso et al. (2021) when conducting a survey in 18 states to assess the level of knowledge of the population about raw milk, showed that 21% of respondents consumed, among these, 18% ingest it 1 to 2 times a day. 68% believed it to be healthier than pasteurized and 43% justified that the reason would be the lack of preservatives compared to the pasteurized and UHT and 9% responded that they would absorb more nutrients.

Martins et al. (2013), when estimating the consumption of informal milk and dairy products and the knowledge of the population about their harm to public health, in São Paulo, found that the purchase was 12.80% from street vendors and 16.13% of the purchase was direct from the producer. They also observed that 31.18% and 83.47% of consumers prefer, respectively, the purchase directly from the producer, claiming it is healthier and with less preservatives, or because it is a fresh and tastier product, in addition to having a more affordable price. The preference for the raw product is given because it is "stronger", "healthier" or "purer".

Rocha (2013), when evaluating the occurrence of *M. bovis* in artisanal rennet cheeses and factors associated with the consumption of informal milk and dairy products, identified that the current consumption rate is 11.4% of raw milk in Juiz de Fora, Minas Gerais. In the state of Pernambuco, a study found that 26.5% of households consumed unpasteurized milk, which could imply risks to public health (LIRO et al., 2013).

According to Costa et al. (2017), upon collecting 15 samples from the informal milk market sold in the southeast region of the state of Goiás, observed that 73% were in disagreement. Similar values were found by Motta et al. (2015) when analyzing quality indicators in

the same segment but in the southeast region of the state of São Paulo, in 100 samples. They observed that 87% of the samples had non-compliant results.

Costa et al. (2020), when verifying the incidence of consumption of unpasteurized milk by the inhabitants of the urban perimeter of Itajubá in Minas Gerais, realized that 40% of the interviewees consume this type of milk. Still, it can be observed that the consumption of the unpasteurized product is related to the sensory issues of the product, since most consumers of this type of product are based on the taste and idea of safety. It was also evidenced that there is misinformation regarding the risks attributed to health and the current legislation.

Prevention and control

The National Program for the Control and Eradication of Brucellosis and Tuberculosis (NPCEBT) created in 2002, follows parameters based on the tuberculin test and on the disposal of those animals with tuberculosis, which in addition to minimizing the risk of infection for the population, reduces the obstacles posed by some countries to export animals and their products, thus reducing economic losses. As it is a disease that does not have treatment, it is therefore recommended to survey the disease on the property through tuberculinization tests. In case of positive animals, they must be isolated and euthanized. The acquisition of animals is recommended from properties certified as tuberculosis-free. In the case of those that do not have control, it is necessary to carry out a test on them at the place of origin and another one right after the animals enter the new property (BRASIL, 2020).

The most commonly reported source of *M. bovis* infection in people is the consumption of unpasteurized dairy products such as milk or cheese, which should not be consumed without this process. To make sure that dairy products have undergone pausterization, it is necessary to check the product label. Care must be taken when purchasing uninspected milk or dairy products. However, the best form of prevention is the clarification and dissemination of this zoonosis, which is a total and indispensable right of the population (Souza, 2013).

Associated with these factors, the best form of prevention is the promotion of knowledge about this zoonosis. Health education is a strategic tool as an instrument to promote the participation and inclusion of society and the agricultural sectors in the fulfillment of health defense. In addition to providing changes in habits and paradigms, there is need for ensuring improvements in the quality of life of individuals (IMA, 2019).

CONCLUSION

Zoonoses have been shown to be a public health problem worldwide and prevent the efficient production of animal foods. Among the main ones are the taeniasis-cysticercosis complex and tuberculosis. The incidence of these diseases is increased in situations of deficient sanitary conditions associated with breeding systems, inadequate facilities, cultural habits and consumption of uninspected animal products. It is necessary to promote knowledge about these diseases. Health education enables the participation and inclusion of society in the agricultural sectors in compliance with health protection. In addition to providing changes in habits and paradigms, it ensures improvements in the quality of life of individuals.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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